

Presentation by Dr. Juan A. Bonnet, Jr., Director, Center for Energy and Environment Research of the University of Puerto Rico at Rural Electric Administration related to the Puerto Rico Electric Power Authority 900 MWe Coal/Oil Project on March 23, 1981 in San Juan, Puerto Rico.

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My name is Juan A. Bonnet, Jr., Director of the Center for Energy and Environment Research of the University of Puerto Rico. It is my purpose today to discuss the convenience of installing three (3) 300 MWe Coal/Oil Plants in Puerto Rico and the desirability of giving high priority in the design of these plants to handle biomass fuel.

Since World War II, our business, industrial, and social lives in Puerto Rico have been shaped by cheap and accessible oil. This has now changed. We know today that we can no longer depend upon foreign oil, which will inevitably run out. As a result, the laws of economics and world politics have forced increases in oil prices. Artificial controls on the price of domestic oil did not make economic sense. For that reason, and to enforce conservation measures, oil prices are being decontrolled in the United States. In recognition of the world situation, Puerto Rico must make the transition to other energy sources.

To accomplish this, we must bring together all of our technical, financial, and human resources. This is an enormous challenge as well as an opportunity. Nearly every discipline has an application in the period of transition. Science, engineering, and social sciences will be involved in shaping an evolving society no longer heavily dependent on oil. But for the next several years, the world will continue to rely on oil, which provided approximately half of the world's energy last year. In the

In the United States, about 46 percent comes from foreign imports, and in Puerto Rico, nearly 100 percent. Until 1985, the most readily available and economical source of additional energy will be conservation - more efficient use of the energy now being consumed.

From 1985 to the year 2000, we will use coal in Puerto Rico. Technologies such as biomass, solar heating and cooling, and Ocean Thermal Energy Conversion (OTEC) will have to compete economically with coal if they are to assume a major role in energy supply. We believe several of them will compete favorably. By this period, we will also have developed conservation and energy efficiency habits. However, coal will be the major source. After the year 2000, the world, including Puerto Rico, will move closer to using renewable energy sources - sunlight and advanced nuclear technologies such as fusion.

But today, we are talking about coal. Coal has a dirty reputation, and rightly so. Mining has killed thousands of people through the years, scarred landscapes, and ruined waterways with acid drainage. Burning it pollutes the air, killing thousands more. No wonder that coal gave way to oil as the world's premier fuel - and no wonder that environmentalists have been wary of turning back to coal, no matter how plentiful. But now it seems clear that they, and all of us, had better take another

look. Coal may be good for the world, and especially good for America, during the remainder of the century.

An internationally sponsored World Coal Study, issued in April 1980 after 18 months of work (and at a total cost of \$2 million), offers a surprisingly upbeat prognosis for expanded coal use in the next two decades. The study contends that oil now costs so much that it is possible to spend heavily to clean up coal and still come out far ahead. And it predicts that coal can compete successfully against oil in export markets. The United States could become a Saudi Arabia of coal exporters. This is a rosy vision. But if it is even remotely accurate,

The old image of coal is clearly wrong. Coal can fill the world's energy gap for at least two decades without threatening major environmental damage. The central message of the report--compiled by Prof. Carroll Wilson of MIT and experts from 16 countries that produce and use most of the world's coal--is that coal use must be tripled and coal exports increased at least tenfold if the world is to solve its immediate energy problems. What are the alternatives? Conservation alone cannot contribute enough. Nuclear Power is meeting increasing resistance. Solar and other renewable energy sources cannot be developed and widely marketed until about the year 2000. So, in the meantime, most of the added energy needed for moderate economic growth must come from coal.

That can be accomplished, the report contends, without sacrificing health, safety, and environmental protection. The reason: Oil is now so expensive that it is economical to clean up coal. The cost of mining, transporting, and burning coal in the USA, even after applying the strictest environmental standards, is roughly \$60 a ton; the equivalent amount of crude oil would cost about \$165. That gives coal an enormous price advantage that could be used to meet even stricter environmental standards, if deemed necessary. And the price gap is getting bigger, not smaller.

Coal's greatest environmental threat is thought to be the "greenhouse effect" -- the possibility that carbon dioxide produced by burning coal and other fossil fuels might cause catastrophic changes in global climates. On this danger, the Coal Study notes, rightly, that there are many uncertainties as to whether such changes will occur. And, even if they do, coal may not make much difference. If the effects do prove serious, the report says, coal combustion can be cut back. That seems a reasonable approach -- if the world is really prepared to take the necessary control steps at the time.

The export potential for coal is often overlooked, even by the American coal industry itself. The United

The United States has by far the biggest export potential, followed by Australia and South Africa. By the year 2000, coal could become America's fifth largest single source of foreign exchange --- not to mention a benefit of incalculable value: greatly lessening the United States' dependence on imported oil. The World Coal Study is more upbeat than many previous reports on the potential for coal. However, its projections are not outlandish. The goals can be reached through a 5 percent annual growth in coal production, a level that has been met in recent years. The study calls for a prompt start on building the transportation and equipment needed for a large expansion in coal use. It also seeks government action to speed licensing, stabilize environmental standards, and encourage investment, to shatter the oil cartel's domination of world energy.

What is the meaning of coal to Puerto Rico from a benefit standpoint? The Center for Energy and Environmental Research (CEER) is performing under contract to the Puerto Rico Electric Power Authority ecological (marine and terrestrial) data collection at two sites on the west coast of Puerto Rico. The two sites are Punta Higuero in the municipality of Rincon and Carrizal in the municipality of Aguada. The data is being taken carefully, following the specifications provided and are regarded as adequate for the licensing procedures. We welcome the opportunity to participate in this particular phase of the program.

This data is available to be used by PREPA in conjunction with the standard federal environmental licensing process to help secure licensing for the plan. Moreover, the Center for Energy and Environmental Research recently concluded an engineering and socioeconomic study on energy alternatives. In this study, a 450 MWe coal plant is assumed to be built with all the necessary environmental protections to burn high-sulfur coal, which could be the available source under supply conditions of an emergency nature. The investment cost includes facilities such as...

Port, coal handling, sludge treatment and fixation, among many other extras. The operation and maintenance included additional costs for the flue gas desulfurization systems and a staff twice as large as the one at the Aguirre Steam Plant. The total capital cost, including inflation and interest during construction, was close to \$1,600/KWh for a 1985 in-service date. Even with all these penalties, the coal plant's electrical production costs were less than one third of the cost of an oil-fueled plant during the plant's lifetime. The first year costs (1985) were as follows: Coal Plant -- 63.5 mills/KWh net (approximately 6.3¢/KWh net), Oil Plant -- 101.34 mills/KWh net (approximately 10¢/KWh net).

Levelized cost during plant lifetime (35 years): Coal Plant: 95.9 mills/KWh net (approximately 9.5¢/KWh net), Oil Plant: 307.4 mills/KWh net (approximately 31¢/KWh net). The differential cost during the lifetime of the facility accounts for an annual saving for the Puerto Rican people of \$572 million in favor of the coal plant. During the first year of operation, due to a smaller price differential between oil and coal, the savings are approximately \$105 million in favor of the coal plant. This large cost differential in favor of the coal plant, designed and built with all the additional equipment, is in harmony with the recent results of the Coal World Study. In reality, modern coal-fired power plants can be designed to emit less pollution than most oil-burning plants. Replacing old oil plants with new coal plants could actually improve air quality. These studies performed by CEER are used as the economic reference frame for cost comparison of the solar renewable technologies with which they have to compete. CEER research and development efforts and energy analysis indicate that biomass is probably the closest alternative to compete favorably with coal.

Excluding nuclear plants, the lowest predicted cost of electricity results from power plants burning biomass, with assumed escalation rates of 8% per year until

In 1985, the average production cost for the first year of electricity from a biomass-fueled plant was predicted to be 4.58 cents per kWh. With an assumed escalation of 5% per year beyond 1985, the levelized cost of electricity during the lifetime of the plant (assumed to be 35 years) is 7.13 cents per kWh. If this is compared with the corresponding costs of electricity calculated for a coal plant

equipped with Flue Gas Desulfurization Systems, operations of a biomass plant cost between 25% and 28% less.

At the request of the Government of Puerto Rico, a major one-year study was conducted by the National Academy of Sciences to determine Puerto Rico's options for alternative energy sources. The Biomass Program of CEER, now in its fourth year, is in conformity with the National Academy of Sciences' recommendations for biomass research in Puerto Rico. Among the recommendations were the following:

"Of all the alternatives discussed, biomass cropping based on the present sugarcane industry has probably the largest potential. It could produce a significant fraction of the island's electricity, with bagasse as fuel, by the year 2000. All in all, energy cropping may in the intermediate terms be for Puerto Rico the most important renewable energy source. Given vigorous development, it might provide 10 percent or more of the island's electricity by the year 2000. Ethanol produced as a co-product could eliminate the Puerto Rican rum industry's dependence on imported molasses and also supplement gasoline supplies."

We have calculated that by converting the 75,000 acres of land currently being used for sugar cane into CEER Energy Cane, an equivalent of two 400 MWe plants could be supplied with biomass. This could be our first indigenous renewable energy source in our island. Consequently, the coal plants should be designed to also be able to burn biomass fuel. It is our strong recommendation that planning be incorporated in the design and construction of the coal plants for possible future conversion to biomass.

Coal/Biomass Direct Burning: In summary, coal represents, for the short term, the most practical and economical alternative that is politically and socially acceptable for electric power generation in Puerto Rico, as long as all steps are taken to ensure that the plant is constructed and operated in a safe and environmentally acceptable manner. However, we should think of coal as a transitional fuel en route to the use of biomass, Puerto Rico's own renewable energy source.

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